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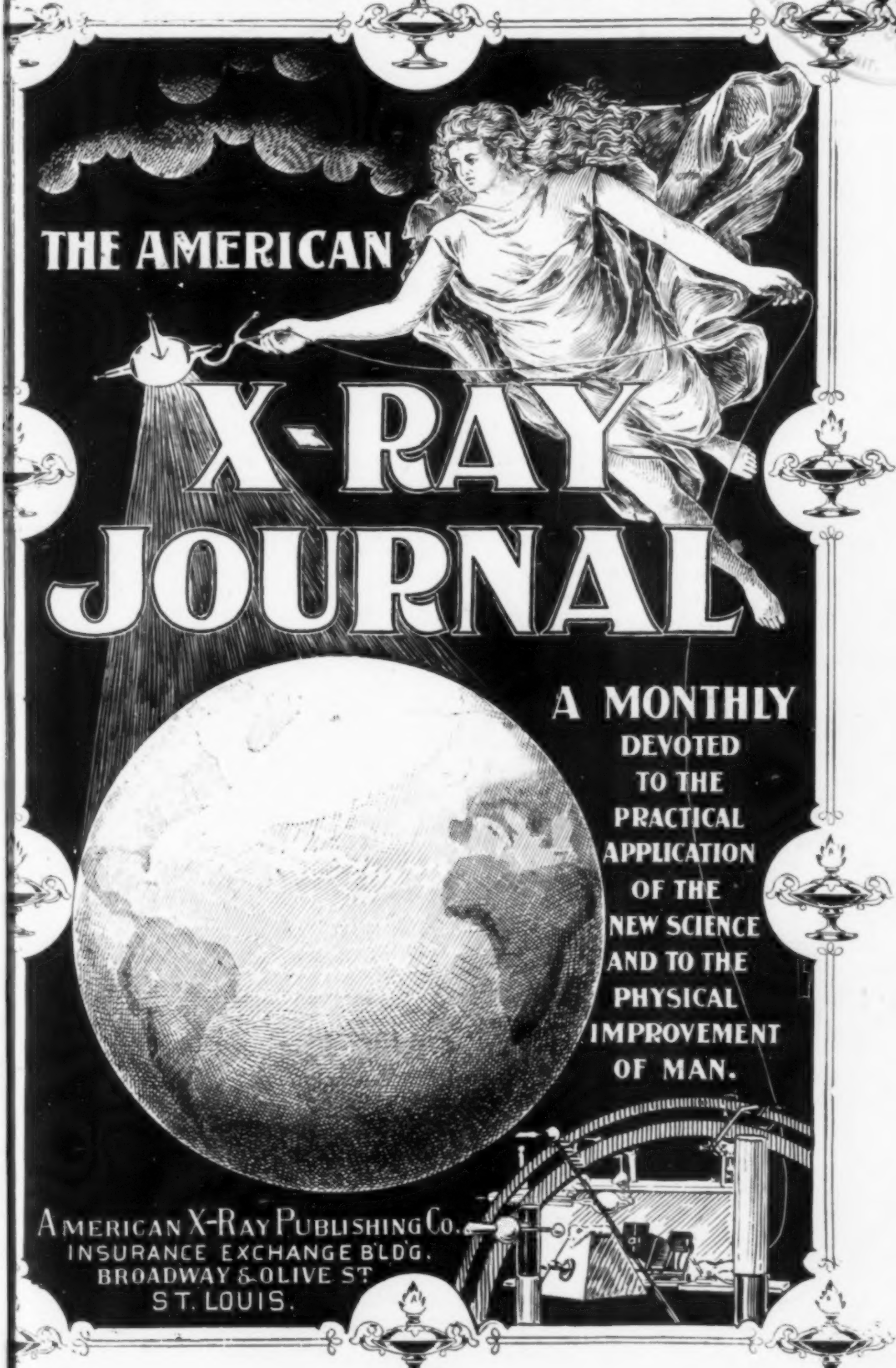
THE AMERICAN X-RAY JOURNAL



A MONTHLY
DEVOTED
TO THE
PRACTICAL
APPLICATION
OF THE
NEW SCIENCE
AND TO THE
PHYSICAL
IMPROVEMENT
OF MAN.

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BROADWAY & OLIVE ST.
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Devoted to Practical X-Ray Work and Allied Arts and Sciences.

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X-RAYS AND ELECTRO-THERAPEUTICS IN LONDON.

Editor AMERICAN X-RAY JOURNAL:

In common with perhaps the majority of American physicians I have held the idea that Berlin and London were really far ahead of New York in scientific work in these fields and that we in the United States had much to learn here. I was very desirous of coming to London at least to compare results and technique with our own and to better fit myself for next season's work. No one can sum up London in a few words, for in this huge city a great deal of the best private achievement never reaches public print or knowledge and hence what I write must be taken to represent only what I have actually seen or heard from reliable sources. Regard for many courtesies shown me by members of my profession here will lead me to make all my remarks impersonal, for a stranger may be easily misled by report and do injustice without intent.

Certain straws in press notices led me to expect a great deal from London. Before reaching England I had read in the *London Graphic* how King Menelik, of Abyssinia, had stated to the mission visiting him recently, that "amongst the many new inventions which he wished to see, the Roentgen ray apparatus had the greatest interest for him."

This seemed to indicate strong British backing for x-ray work, and floating paragraphs like the following pointed to an official recognition somewhat beyond our slow American progress:

THE BATTLE OF ATBARA.

"General Russel, M.P., will put further questions to-morrow in the House of Commons relative to the medical arrangements at the recent battle of Atbara.

"He will ask the Under Secretary whether complaints have reached him that the medical arrangements for the reception of the wounded British officers at Cairo were insufficient and unsatisfactory; that seven wounded officers were put into one small ward and that the nursing staff was entirely inadequate; whether no apparatus for the application

of the Roentgen rays was carried with the field army; and whether there is reason to believe that some lives of wounded officers and men might have been saved had these appliances been available."

But yesterday the Prince of Wales slipped and broke his patella and the press at once announces that x-rays were used to examine the fracture. The fact is, however, that the work is done here very largely outside of the medical profession and so many minor differences exist in details of apparatus and methods that until each has seen the apparatus of the other, an American and an English surgeon can not talk intelligently in the same language about the same things.

My first forcible encounter with this curious fact was occasioned by the fluoroscope,—in our hands a convenient, practical instrument which is easily used and which we could not do without. Dr.—— was showing me his apparatus about dusk but apologized for not working a tube as "it was yet too light to use the screen,' and he had no means of darkening his office. I saw no reason for not using the fluoroscope and so remarked, whereupon he showed me his "screen" and I at once perceived that it could only be used in the dark. In reply to my question as to why he used such a screen and if it was superior to the fluoroscope, he raised objection to the latter that I could not understand at all. He spoke of its great weight, large and clumsy size, difficulty of holding it up, using both hands, &c., so that I felt utterly ignorant on the subject of fluoroscopes and was eager to become acquainted with better and "more convenient" screens. In due time I shall explain about screens but will now begin at the beginning of my letter and try to write the chief points of interest both for American physicians and makers of apparatus.

In the first place the London Roentgen Society is growing in membership and has now nearly 100 associates. As no meetings are held during the summer no papers or reports of progress will be presented until the winter session. There is said to be little prospect of much practical development in x-ray advances through the agency of the society. But the influence of the members will be felt. In at least one direction the society has work before it of great importance. Unfortunately x-ray work is mostly done here by the clerks in the shops which sell coils and tubes. Several of these dealers have a dark room in their shop, and portable apparatus at call. They have a routine of work. Patients are sent them by surgeons, or they are ordered to go to the patient's house and make a picture which is handed over to the surgeon for interpretation. The charge varies with size of plate, &c., but all pictures are paid for. Only a few hospitals are equipped with apparatus and when a hospital case is sent to the dealer for a picture the usual fee is from $2.50 to $5.00 paid out of the funds of the institution. Private cases pay about $15.00 for a picture taken in the shop, and when the coil is moved to the house or another town the cartage and time is added. The dealer is always paid for his services, but by retaining in his own hands so much of x-ray work he tends to cut off the market for his apparatus. His excuse is that medical men will not go to the trouble to do the work themselves.

On the other hand, physicians who are doing the laborious work of the x-ray departments already established in some of the leading hospitals, receive no pay and seldom get a case in private practice, for the dealer gets them. There is a growing feeling that an effort must be made to reform this unfair arrangement and if the Roentgen Society acts in the

matter to secure both the work and the proper fees to the medical profession, it will help the cause.

The Prince of Wales is attended by several surgeons and the daily paper report of the consultation had in it the remark: "One of the first requirements was to ascertain the precise character of the injury and it was decided to employ the x-rays for this purpose. A specialist was called in early in the afternoon and photographs of the injured knee were taken." The "specialist" called in was probably a shop keeper's assistant. The whole plan is a bad one and should be reformed.

I shall now take up in turn the subject of apparatus, results, &c. Practically, the whole work here is done with plain Rumkhorf coils. I have seen many of them in operation and, as usual, the effectiveness of the coil varies with the skill of the operator. No such variety of coil and break-piece devices is known here as our dealers in the United States advertise. The coil in general use is usually 6 or 10 inch spark, has a spring contact breaker and is operated by 4 or 6 storage cells. A few use a rheostat, a very few use a mercury contact breaker, and one dealer showed me a rotary break wheel but said he had never sold one. Some rivalry exists here between English made goods and goods "made in Germany." London made coils are considered the best. A standard dealer retails them for the following prices:

3	inch spark coil about	$ 63 00	U. S. money.
4	" " " "	80.00	" "
6	" " " "	112.00	" "
8	" " " "	138.00	" "
10	" " " "	183.00	" "
18	" " " "	375.00	" "

Only a few "investigators" use an 18 inch coil. This maker told me that all his coils were tested with a small current—3 storage cells of about 8 volts—and with a full current would far exceed the schedule. He said that he had made one of his 3 inch coils give a 6 inch spark, a 4 inch give 7, and his 10 inch coils would average 20 per cent over length of bobbin. Certainly the 10 inch coil he kindly demonstrated to me gave as good a current as any coil I ever saw work. He used a 6 cell portable battery and no rheostat, but controlled the action of the coil from a half inch mild discharge to a superb thick spark of 12 inches by the cell switch and screw of the vibrator.

I may mention here that the only alternative coil I have seen anywhere in London is the Tesla. Nearly all the hospitals and surgeons I have visited have one standing aside. Physicians call my attention to it and remark that they bought it some time ago in hope of getting a greater bombardment but could not make it work satisfactorily and abandoned it. I state the fact here and if our American makers can see what the trouble is and correct it I think the Tesla coil would sell better here than any other. The fault is probably a lack of care or skill.

Portability is considered a prime requisite in nearly all the apparatus used here and no stationary equipment is seen.

What about the static machine in x-ray work in London? If the editor of this journal should search through the United Kingdom he could not discover *one*. The useful and practical machine with which I have worked and of which I have written is *absolutely unknown here*. What I say about its simplicity, effectiveness and satisfactory action can not be comprehended by Englishmen who have not seen it.

When I speak of electro-therapeutics I will explain more fully about static apparatus in this country. The few who possess a Wimshurst machine of large size have a good generator of current but lack practical means of using it. They are blind to this shortcoming. If my apparatus was here I could surprise

the London profession to a considerable extent.

The fluoroscope is almost unknown here and is practically ignored. Britains build in massive style. American lightness of structure is wanting here in many ways, and the fluoroscope is one of them. The convenient and indispensable instrument made by Messrs. Aylsworth & Jackson is unknown in London. I think no medical man from even rural America could look at a London fluoroscope without laughing. I have seen about twenty—no two exactly alike and none of them fit for use. If I could dictate this letter to a typewriter I could describe many details about apparatus, but the pen is so irksome to a hurried sightseer who is searching for rest that a full description of the "barbaric London fluoroscope" must be omitted. Nor can men here grasp my meaning when I tell them that our fluoroscope is very light, can be used in daylight, is held easily in one hand, fits the eyes perfectly and excludes all radiance save that from the tube. Operators here use only the screen mounted in a small wooden frame. They can not work as we do but require a dark room for the simple examination with the eye. For this reason it is a routine to go ahead at once and "take a picture." During the exposure the action of the tube is not observed with the screen nor is its efficiency tested beforehand. I have been surprised to note that almost all x-ray examinations here are made in a routine and chance manner, there being very little appreciation of refinement of detail or the value of our accessory devices. Not having them they do not miss them. The open screen does, however, possess two advantages. Eyes with different focus can accommodate the distance at will, and tracings are more easily made than with our fluoroscope. Still, actual work for patients is almost limited to taking a picture in a routine way. The sum total of work done in this manner is very large. At one hospital about 1000 x-ray negatives have been made during a year and a half. An intensifying screen is rarely used. One dealer told me they were a novelty here and had only been introduced in May. Others say they were used six months ago, but were then of a poor quality. Mr. W—— states that although they were employed a long time ago, yet it has been only of late that a fine photographic screen could be obtained. Whatever the facts are, I observe that no general use is made of them in London. Exposure times are about the same here as with us. Our plate makers are perhaps more enterprising in wrapping and preparing plates for convenient use. The troubles of London operators center about tubes. Tube manipulation here, as my students are taught it, is unknown. I have seen work done by nearly all the varieties of English and German tubes sold here. No point of superiority appears in any of them. An Owen & Co. adjustable tube is also made here and the dealer admitted to me *sub rosa* that it was "an American idea". Some operators complain that the light tubes sold break in a few days and one surgeon destroyed four in a half hour. In hospital and other practical work, therefore, a preference is shown for a German tube of very heavy construction which lasts a long time. The life varies, however, with the skill of the operator and with the current used. One surgeon in a large hospital has found them very durable, lasting him for an indefinite number of months (one being bought as long ago as October, 1897) while in another hospital the operator stated that a new tube (of the same kind) would reach its maximum in about three days, remain good about a week and then last for small work for a month.

For the last half year a special effort has been made to get away from plati-

num as an anode. The chief metal exploited so far has been osmium, a rare and high priced substance which will soon pass. Its alleged advantage is said to be a melting point of about 750 degrees higher F. than platinum. A small nugget is fused into the center of an anode disc of cheap metal, and the electrodes are set near together in the hope of catching the cathode stream at its finest point, and hence, improving definition. Some are enthusiastic over osmium tubes even at the price of about $15.00, but conservative men best qualified to judge are in doubt and reserve judgment. My own belief is that their supposed superiority arises from the inferiority of the average tube used here, and I do not recognize the alleged need of finding another substitute for platinum. This noble metal is abused here by tube makers and deserves better treatment at their hands. A thin scale of platinum is laid on a disc of aluminum and expected to stand the heat of a 10 inch coil current. It does the best it can and endures wonderfully, but if makers would be more liberal in the quantity they use they would greatly oblige operators and prove that no other metal is required. In variety and working qualities the U. S. appears to far surpass England in tubes and I have never seen here a single specimen of the large, substantial, thick platinum anode now furnished in leading American tubes.

Mechanical comprehension seems to be defective among makers here. They have had marvelous encouragement. A few wealthy amateurs have devoted themselves to the scientific development of x-ray work in a manner which is astonishing. For instance, I hear of one who had a fluorescent screen 6 ft. by 2 ft. made to assist his investigation. I hear of a Wimshurst static machine of 120 plates 36 inches in diameter. One distinguished surgeon told me that he had personally spent nearly $5,000 on x-ray apparatus. Yet a chain is no stronger than its weakest link, and in every case the tube is one of the vital points. The great hindrance to the cause of x-ray diagnosis in England (as with us in the United States) is not, primarily, the lack of good tools or skill to use them, but it is to be found in the fact that all-round knowledge and skill is not combined and widely *distributed*. Dr. A. takes up the work and develops certain uses of x-rays with the genius of his ripe experience and training in his branch of professional practice. Dr. B. does the same in some other line of work. Dr. C. adds his quota to the splendid whole and if one operator could do all that A. B. and C. collectively do, he would be a master of technique. But no one operator becomes able to demonstrate this all-round skill; scientific advances remain fragmentary, and while theoretically rapid and even magnificent we find in practice only the average operator and his ordinary routine. This is the case here. I have been delighted a number of times by interesting demonstration shown me by men who are esteemed as leaders in England, only to find that in ordinary work their striking developments are ignored. Remarking only that among instruments the Dennis fluorometer seems to be unknown here, for I can find no one who has ever heard of it.

I must close this portion of my letter and leave "results" and electro-therapeutics to another time.

S. H. MONELL.
856 Union Street, New York City.
London, Eng., July 22, 1898.

VISIBILITY OF X-RAYS. Courmelles. *L'Eclairage Elec.*, April 30.—An abstract of an Academy paper in which he describes experiments made with young blind subjects. Out of 204 there were nine who could see the rays. It is not possible to draw definite conclusions from the observations.

BULLETS IN THE BRAIN AND THE ROENTGEN RAYS.

Von Bergmann (*Berl. Klin. Woch.*, May 2, 1898) *Gaillard's Medical Journal*, July, refers to 32 cases of bullet wounds of the brain which he had observed, and in which the bullet has been left undisturbed. Of these, 8 were severe cases, and the patients rapidly died. Of the remaining 24, 19 recovered, and these had remained well. Of the other 5, 2 developed an abscess of the frontal lobe, and both subsequently died, although the abscess was opened; 2 others died apparently from a suppurative meningitis and the fifth had not been heard of. The patients who recovered either showed no symptoms or were unconscious for a short time, or had a local paralysis or spasm. It is possible that in the first named group of cases the bullet did not penetrate the brain substance. Thus it becomes important, as Eulenberg has shown, to determine the situation of these bullets by the Roentgen rays. The author gives details of two cases examined in this way. Case 1 occurred in a woman, aged 28, who shot herself in the head when cleaning a loaded revolver. There was severe pain in the head and vomiting, but no loss of consciousness. The site of entry of the bullet was on the nasal side of the left upper eyelid. There was no paralysis. The wound was healed in the second week, and the patient subsequently recovered from an exophthalmos and choked discs. The situation of the bullet was found by the Roentgen radiography to be in the white matter of the occipital lobe.

Case 2 was that of a man aged 25 who was wounded by a revolver shot in the right temporal region three years ago. He was unconscious for three days, and had a left hemiplegia and partial anasthesia. His sight was also impaired and the hearing in the left ear. Very considerable recovery followed. Within the last six months, however, there had been severe attacks of pain in the head, chiefly limited to the right side. Here the situation of the bullet was at the junction of the anterior two-thirds and posterior one-third of the hinder limb of the internal capsule, and this was confirmed by the Roentgen rays. The patient wished to have the bullet removed. During a stay of three weeks in the hospital there was no return of the pain, and the patient was eventually dissuaded from an almost certainly fatal operation.

Von Bergmann says that both cases supply evidence in favor of leaving these bullets alone. The treatment should consist in not searching for them, and in a most rigid protection of the wound against infection. When the bullet lies in or near the bone without penetrating the brain, the treatment described may not be suitable, and the Roentgen radiography should determine the situation, and hence the treatment. The author refers to a case in which the bullet had not even penetrated the skull, but lay outside it.

PROPERTIES OF BECQUEREL RAYS. Stewart. *Phys. Rev.*, April.—A summary of the present state of our knowledge on the subject, and its bearings on the subject of x-rays. He concludes that there can be no doubt that they are transverse ether rays; transmission by metals indicates that the wave lengths must be shorter than that of any ultra violet rays which have been obtained from any light source. Like x-rays, they are not homogeneous; the similarity between the two rays is very striking, the principal difference being the absence of any reflection or refraction of x-rays; this leads to the conclusion that x-rays are also transverse waves shorter than Becquerel rays; the similarity of both presents a strong argument in favor of the theory that x-rays are short, transverse ether waves.


Gun shot fracture

THE X-RAY DIAGNOSIS IN CHILDREN.

A. V. L. BROKAW, M. D.

The science of radiography and fluoroscopy in its application to children is of extraordinary value; the scope, utility and application being as wide as in the adult. By reason of the alleged harmful effects, and believing the more delicate organism of the child to be susceptible to a greater degree to the untoward influence of the new form of radiation, many surgeons have been deterred from the frequent use of x-rays in children. That such is the opinion of many is a matter of regret. I feel quite confident that this reasoning will not be sustained after a further consideration of the subject. After large experience, I can but come to the conclusion that the adaptation of this discovery merits a wider application and more general use than is at present in evidence. The danger of burns and deep-seated tissue degeneration has been reduced to a factor so slight that it does not merit the dignity of very serious consideration. In the early experimental stage of the development of this new diagnostic aid, burns of varying intensity occurred with a frequency sufficient to arouse general attention, especially as the daily press found these accidents news items worthy of publication. Happily, such accidents are rare in comparison with the thousands of exposures being made the world over. The destructive effects, the accidents, it will be noted, have followed where the operator used a coil apparatus. As far as I am aware no serious effects have presented themselves when the source of generation of the rays has been effected by static machines. This source for generation of the rays, I believe, to be the best, and undoubtedly the safest in the examination of children, and it is therefore recommended. By the exercise of tact children manifest little fear of the apparatus, as it is almost noiseless.

Even very young subjects are often more tractable than nervous adults. Fluoroscopic examination should be as short in duration as possible. A good radiogram, to my mind, is of greater value than the momentary appearance of a shadow cast upon the screen. To secure a radiogram, or even more than one, requires but little more time than a careful fluoroscopic examination. Especially is the above true in children. It has been my custom to secure the part to be radiographed to the sensitive plate by a few turns of a roller, or a strip or two of adhesive plaster, thus reducing blurring and double images to the minimum by an easy restraint. The time necessary for exposure in children, to secure good results, is fortunately much less than in adults, the tissues being singularly easy of penetration, and the detail all that could be desired. The certainty of location of foreign bodies in any part of the economy in children is a matter of satisfaction. The assurance that such foreign body will appear upon the plate is looked forward to with a degree of positiveness, which does not obtain in the adult at all times.

The advantages of a routine use of the x-ray, as a necessary part of an office equipment, should appeal to every surgeon. So numerous are the occasions for the use of the apparatus that to-day we would feel at a loss without it. No surgeon can dispense with this diagnostic aid, and the same necessity in the near future will appeal to the physician. In the diagnosis of intrathoracic diseases it is a fact that, as an adjunct to the methods of physical diagnosis, most positive information is given to those capable of interpreting fluoroscopic appearances. A grand field is to be opened up in this direction by those interested particularly in internal medicine. To those

whose instincts and work run in the line of general surgery, a brief enumeration of a few instances of the routine utility of the new agency may not be without interest. It has been my pleasure to locate bullets in the head, thorax and thigh; indeed, in all parts of the economy. The location of the same in the extremities is never difficult to radiograph, clear, distinct pictures being uniformly obtained. The location of foreign bodies in the head, lumbar vertebra and upper sacral region requires in adults, at times, more than one exposure. In children the purely mechanical difficulty of penetration does not apply by reason of diminished distance through the parts and the ease with which the rays pass through histological structures possessing less density. The study of unusual joint lesions, dislocations, fractures and the differential diagnosis of obscurities in the osseous system demand, for intelligent management, x-ray examination. The text-books of surgery and anatomy will necessarily, in part, require to be rewritten, owing to the revelations at variance with past teaching and ideas. The excuse that the conditions in a fracture-dislocation about the elbow can not be determined, by reason of great swelling of the soft parts, will not, in the future, prevail. An examination with the fluoroscope, or the positive evidence of a radiogram, will establish with certainty the conditions present and enable the attendant to make a prognosis as to the future of the joint, thereby protecting in a measure the attendant from the all too frequent damage suits. The detection of gall-stones is a matter of uncertainty and no assurance may be given in any case that their presence will be demonstrated. Urinary calculi lodged in any part of the tract present fewer difficulties. Stone in the bladder in children is usually to be demonstrated. From a large collection of radiograms a few illustrative of x-ray diagnosis in children are exhibited. The half-tones, while of most excellent workmanship can not do justice to the original negatives.

No. 1 shows a marble impacted in the lower end of the esophagus. The boy, aged 5, was brought into the office from the street by a passing pedestrian, who found the child gasping for breath, in fact, in a critical condition. A playmate gave the information that his unfortunate companion had had several marbles in his mouth and had been suddenly seized with a choking spell. The marble could be felt through the cervical soft parts. We could not grasp the foreign body with forceps, and in manipulation by external pressure the smooth, round "flint-glass" marble passed downwards the child was immediately relieved, as far as urgent respiration symptoms were concerned, but the pain was intense until it reached the stomach. The fluoroscope revealed the marble *in situ*, and I could not resist securing a radiogram. A five-minute exposure was at once made. A few moments later the marble must have passed into the stomach, as all pain suddenly ceased. The subsequent history of the case is without interest, as two days later the object passed *per viam naturalem*.

Fig. 2 shows distinctly the absence of the head of the femur through tubercular disintegration, and the empty acetabulum.

The radiogram, Fig. 3, shows a five-day-old subject, injected with liquid mercury. To the anatomist the study of injected vessels is particularly interesting, the relationship to the osseous system showing far better than some dissections.

The early differentiation between primary acetubular disease and tubercular disease of the head of the femur is only


Compound fracture leg both bones boy age 10 yrs

FIG. 1.

FIG. 2.

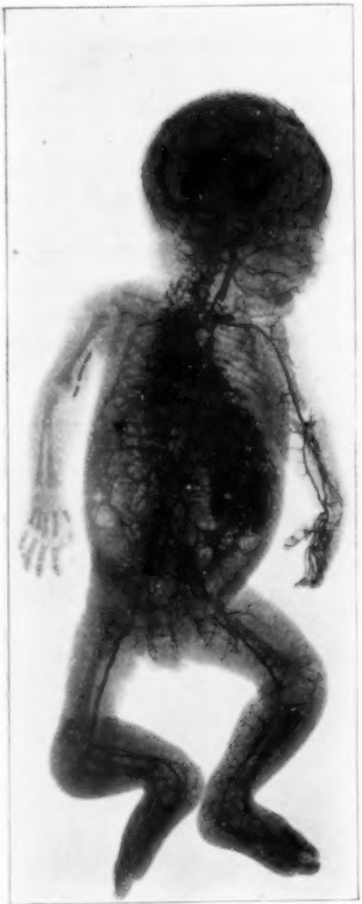

FIG. 3.

FIG. 4.

FIG. 5.

possible, with certainty, by means of the Roentgen rays.

Fig. 4 the appearance after resection and removal of the diseased bone.

Fig. 5 illustrates a typical tubercular knee in a little girl.

The radiogram of the elbow, Fig. 6, one of many, illustrates the thickening in fractures through the condyles. After an experience in making over five hundred radiograms, it might be formulated, that the younger the subject, the shorter

FIG. 6.

the exposure. The results we have obtained can be equaled by any one, probably surpassed by many, so no claim is made for superior knowledge of the subject. Our object will be obtained if these hurried jottings lead others into the field.

3147 Washington Avenue, St. Louis, Mo.

[From June Number (Vol. XI.) Annals of Gynecology and Pediatry, Boston.]

ROTATION OF CATHODE RAYS. Braun. *Wied. Ann.*, No. 6; abstracted briefly in Lond. *Elec.*, July 8.—A thin bundle of cathode rays strikes a fluorescent screen at the end of a vaccum tube; a bar magnet penetrates through the vacuum through this screen and is protected by a glass tube, the rays then form a ring around the bar magnet. He investigated "whether this ring represents the influence of cathode rays, which are in a state of rapid rotation around the pole;" several tests showed that there was no evidence of rotation.

EXAMINATION OF COAL BY X-RAYS. Couriot. *Eng. and Min. Jour.*, July 2. —A brief abstract of a French Academy paper. He states that x-rays afford an

instantaneous and certain means for determining the purity of mineral fuel; coal, diamond and wood are permeable to these rays, while silica and silicates are opaque; thus the silicious ash, forming constituents of coal, obstructs the passage of the rays; owing to the great transparency of coal, it is not necessary to trim the sample, large fragments sufficing for the test; impurities are clearly shown as dark spots. A 10-inch spark coil will answer, with an exposure of about five minutes, the samples measuring 1.25 to 2 inches. A brief account is also given in *L'Eclairage Elec.*, June 18.

ON THE SOURCE OF THE ROENTGEN RAYS IN FOCUS TUBES.*

BY ALAN A. CAMPBELL SWINTON.
Communicated by Lord Kelvin, F.R.S. Received June 7th, read June 16th, 1898.

The writer has already described ("Some new Studies in Cathode and Roentgen Radiations," a discourse given at the Royal Institution on February 4th, 1898) how he has found it possible to study by means of pin-hole photography the active area on the anti-cathode of a focus tube from which the Roentgen rays proceed.

By means of a special camera he has now been able to make further investigations. The camera is illustrated in Fig. 1, where A is the pin-hole in the removable lead disc secured by a brass cap to the brass cone B, which is lined with thick lead so as to be opaque to the Roentgen rays. D is a framework into which slides either the fluorescent screen E, or a carrier containing a sensitive plate should photographs be required. F is an observation tube for use with the fluorescent screen. It is made of insulating material to avoid danger of shocks.

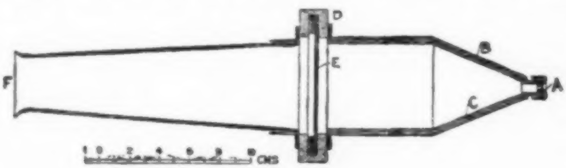

FIG. 1.

With this apparatus directed at the anti-cathode of a focus tube, it is easy with the fluorescent screen in place to take accurate note of the image of the active anti-cathode area which appears on the screen, and to observe the variations in form, dimensions, and brilliancy that take place under varying conditions. Similarly by replacing the fluorescent screen by a photographic plate in a black paper envelope, the Roentgen ray image can be photographed. Exposures, varying from 1 to 30 minutes, according to conditions, are found sufficient to impress upon the plate any effect that can be seen directly with the screen. It has not, however, been found possible, even with very prolonged exposures, to photograph anything not directly visible with the screen, and having regard to the difficulties of maintaining the vacuum and other conditions constant for any considerable length of time, the method of direct observation seems generally to be the best and most convenient. For direct observation, rather a large pin-hole, say, about 2 mm. in diameter, gives the best results; for photography about half this diameter is preferable, as it gives sharper images.

The writer has made numerous observations and photographs with this apparatus, both with focus tubes of the ordinary pattern, and also with a special tube in which both the cathode and also the anti-cathode (which in addition acted as anode) were independently adjustable along the axis of the tube, so that the distance between them could be varied from a minimum of 4 to a maximum of 14 cm. This special tube is illustrated in Fig. 2, and during the observations it was connected to a mercury pump so that the degree of exhaustion could be varied as desired.

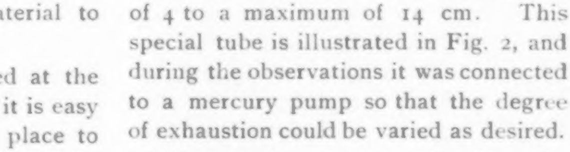

FIG. 2.

The following are the main effects observed:—

1. When the anti-cathode intersects the cathode stream at the focus, the dimensions of the active area are independent of the degree of exhaustion. For all other positions beyond the focus it is larger the lower the exhaustion

*Paper read before the Royal Society.

and *vice versa*. These observations are, of course, only possible between the limits of exhaustion with which Roentgen rays are produced.

2. When the anti-cathode intersects the cathode stream beyond the focus, the active area is larger the greater the distance between cathode and anti-cathode. For instance, with the tube illustrated in Fig. 2, exhausted to a good Roentgen ray vacuum, it was found that the active area gradually increased from about 0·15 cm. diameter with 4 cm. distance between cathode and anti-cathode up to about 2·3 cm. diameter as the distance was gradually increased to 14 cm. The increase is less the higher the vacua, but is always very considerable.

3. When the anti-cathode intersects the cathode stream considerably beyond the focus, the active area is found to consist of a well defined and very intense central nucleus, surrounded by a much fainter, but quite appreciable halo. Both of these increase in size as the distance between cathode and anti-cathode is increased.

In some cases the halo consists of a well marked hollow ring with a dark space between it and the central nucleus. In other cases two distinct concentric rings are visible surrounding the nucleus. Moreover, the nucleus itself, when very large, shows distinct signs of being made up of one or more concentric rings, sometimes with a still smaller nucleus within them. These observations correspond with and amplify what the writer has already noticed by direct observation of the visible luminescence of a carbon screen arranged to intersect the cathode stream.†

4. With an anti-cathode inclined at an angle of 45 deg. to the axis of the conical cathode stream it is found that those portions of the stream which impinge most normally upon the anti-cathode surface are considerably the most efficient in producing Roentgen rays. Similarly those portions of the stream that impinge on the anti-cathode surface very much on the slant are correspondingly ineffective in producing Roentgen rays.

5. At the degrees of exhaustion most suitable for producing Roentgen rays, and with concave cathodes of the usual dimensions, the cathode stream proceeds almost entirely from a small central portion of the cathode surface, the remaining portion of the surface being apparently practically inoperative. That this is so was very conclusively established by photographs taken with the tube shown in Fig. 2. In the manufacture or subsequent exhaustion of this tube three very minute fragments of glass by some means attached themselves on to the concave surface of the aluminum cathode, and remained fixed there during the experiments. The cathode itself was 29 mm. diameter, and the radial distances of the three glass fragments from the centre were respectively about 9 mm., 4 mm., and 2·5 mm. In all the pin-hole photographs of the anti-cathode of this tube with which the enlargement of the active area was sufficient, the shadows of the two glass fragments nearest to the centre of the cathode are clearly visible, while in none of them is there any appearance of the third and outer fragment. It, therefore, is evident that the whole of the cathode stream that was effective in producing Roengen rays came from an area of the cathode surface less than 18 mm. diameter, or less than two-thirds of the full diameter of the cathode. Further, in each case the shadow of the two inner glass fragments appeared outside of the central nucleus, showing that the whole of the more intense portion of the cathode stream proceeded from a portion of the cathode surface less than 5 mm. in diameter. These results confirm the writer's observations made with carbon cathodes.‡

†See Proc. Roy. Soc. Vol. 61, pp. 81–84

‡Ibid, pp. 92–93

6. The different portions of the cathode stream proceeding from the different portions of the cathode, cross at the focus and diverge in a cone that retains any special characteristics of the convergent cone. The relative positions of the two inner glass fragments on the cathode, and the positions and enlargement of their shadows on the anti-cathode for different distances between the latter and the cathode, were found to show this very clearly.

7. Though by far the greater portion of the Roentgen rays given by a focus tube proceed from the active anti-cathode area, still, a very appreciable quantity is also given off by all those portions of the glass of the tube that shows the green fluorescence.

Using a somewhat large pin-hole, this is easily observed by turning the tube so that the more powerful rays from the anti-cathode can not reach the pin-hole, when a Roentgen ray image of the whole of the fluorescent portions of the glass of the tube can be distinctly seen. Further, it is noticeable that that portion of the glass that shows the brightest fluorescence, *i.e.*, that part which lies in the path in which cathode rays would be reflected from the anti-cathode surface were they reflected according to the law of equal angles of incidence and reflection—gives off the most Roentgen rays, while those portions of the glass that show no fluorescence do not give off any Roentgen rays. The conclusion appears obvious that whatever produces the one also produces the other, but as has been pointed out by Prof. S. P. Thompson § and others, the fluorescence is not due to the direct stream of rays from the cathode which cannot reach portions of the glass that show fluorescence, but to some description of radiation that proceeds from the surface of the anti-cathode that faces the cathode. In the paper above referred to Prof. Thompson calls these radiations "paracathodic rays," stating that they differ from the Roentgen rays in respect of their power of penetration, and in their capacity of being electrostatically and magnetically deflectable. In these respects the writer's experiments confirm those of Prof. Thompson, but when the latter goes on to differentiate these rays from ordinary cathode rays, on account of their not exciting Roentgen rays where they impinge on a solid surface, the writer is unable to agree, for as above stated, these rays do excite Roentgen rays where they impinge upon the glass walls of the tube; as mentioned, however, they do this only to an extent that is relatively very feeble, and so far as the author knows only discernable by the pin-hole method of observation, which no doubt explains Prof. Thompson's failure to observe the effect. The "para-cathodic" radiations in question do not, however, appear to be ordinary cathode rays. In the first place they do not proceed directly from the cathode, but only from the surface of the anti-cathode that faces the latter. Secondly they do not appear to be negatively but positively charged, as can be ascertained by means of an exploring pole connected with an electroscope. The writer suggests that, assuming the correctness of the Crookes theory of the nature of the cathode rays, these "paracathodic" rays may very probably consist of cathode ray particles which, having struck the anti-cathode and having thus given up their negative charges and acquired positive charges, rebound, both by reason of their elasticity and also by repulsion from the anti-cathode. Perhaps owing to the comparative roughness of the anti-cathode surface, they fly off to some extent in all available directions, but they do so especially in that direction which the law of equal angles of incidence and reflection requires. It also appears very possible that these "paracathodic rays are identical with the pos-

§See Phil. Trans., A. Vol. 190, pp. 471—493.

itively electrified streams proceeding from the anode, which the writer has investigated by means of radiometer mill wheels, recently described in a paper to the Physical Society.

In any case, it seems clear that in the tubes observed and photographed with the pin-hole camera, the Roentgen rays given off by certain portions of the fluorescent glass are not originated by the impact of an ordinary cathode stream, but apparently by the impact of positively charged streams proceeding from the anti-cathode.

The writer is greatly indebted to Mr. J. C. M. Stanton and Mr. H. Tyson Wolff, for the construction of the apparatus described, as also for valuable assistance in the carrying out of the experiments.

The twenty-fourth annual meeting of the Mississipi Valley Medical Association will be held at Nashville, Tenn., Oct. 11—14, under the Presidency of Dr. John Young Brown, of St. Louis, Mo.

This Association is second in size only to the American Medical Association and has done most excellent scientific work in the past. The annual addresses will be made by Dr. Jas. T Whittaker, of Cincinnati, on Medicine, and by Dr. George Ben Johnson, of Richmond, Va., on Surgery. The mere mention of the names of these gentlemen establishes the fact that the Association will hear two scholarly and scientific addresses.

Nashville is a most excellent convention city and is well equipped with hotels, and with the record of the meeting in Louisville in 1897, as an example, the local profession under the leadership of Dr. Duncan Eve as Chairman of the Committee of Arrangements has prepared to have a better meeting.

Already titles of papers are being received. These should be sent to the Secretary, Dr. Henry E. Tuley, No. 111 West Kentucky Street, Louisville, Ky., as early as possible to insure a good place upon the programme. Reduced rates on all railroads will be granted on the certificate plan.

HENRY E. TULEY, Sec.

The Roentgen Rays In War Surgery.

The English papers of May 21 give considerable space to a lecture delivered on the previous day before the Royal United Service Institution by Surgeon Major Beevor of the army medical staff. The object of the lecturer was to give his experience in the working of the x-ray in military surgery, and to show by the results in the recent frontier expedition in India that the apparatus can be carried on a campaign and be of the greatest possible benefit to the wounded. He maintained, in view of his success, that it was the duty of every civilized nation to supply its wounded in war with an x-ray apparatus, among other surgical aids, not only at base hospitals but close at hand wherever there might be fighting. There is no doubt of the desirability of having this aid in field hospitals nor of the possibility of furnishing it for the field hospital of a particular expeditionary force, but we doubt the ability of an army medical department with our present experience of the x-ray to have it available in the field hospitals of a large army during the hours of activity that follow incoming of the wounded from a great battle. Surgeon-General Sternberg has provided the apparatus for the Philippine expedition, for the hospital ship Relief and for the general hospitals to which the wounded from the field hospitals will be sent for treatment; and the experience thus gained in its applicability to war surgery may lead hereafter to a further extension of its use on behalf of the wounded in war.—*Journal of the American Medical Association.*

ACTION OF ROENTGEN RAYS UPON THE GROWTH AND ACTIVITY OF BACTERIA AND MICRO-ORGANISMS.

R. NORRIS WOLFENDEN, M. D. CANTAB.,
AND
E. W. FORBES-ROSS, M. D. EDIN.

Some work has been done upon this subject, but it has not led to any definite conclusions, and in view of the somewhat conflicting statements published we have thought that further investigations would be desirable.

With this end in view we have selected the bacillus prodigiosus as the first subject for experiment. Six culture tubes of the normal growth on potato were obtained from University college laboratory, and on May 25th these were set to incubate in a Hearson incubator at a temperature of 35 deg. C. in the dark. After five days' growth a tube was taken and from it two fresh cultures were made; one was a simple control culture and the other was rayed along with the mother culture for an hour. After twenty-four hours' growth that in the tubes that had been rayed (i. e., the mother and one of the daughter cultures) had increased markedly in comparison with the original tubes, which had now been growing for six days. The control culture appeared to be only just showing a margin of increase. The difference in growth between the two tubes which had been rayed and the non-rayed control tube was very great, showing that undoubtedly the action of the x-ray tube had been exceedingly stimulative.

In order to determine whether the exposure of the potato to prolonged x-ray action would produce such changes in the medium of growth as to account for any marked increase in bacillary growth, two sterile tubes were rayed for an hour. A culture was then made of one of them from one of the previous tubes which had been rayed and which showed active growth, and another culture was made in the second tube from a culture which had never been rayed at all. These were incubated under precisely the same conditions as the previous tubes. When examimed two days afterward the growth in the rayed potato culture from rayed bacilli, had entirely outgrown the culture on rayed potato from non-rayed bacilli; therefore the only cause of this exceptional growth must have been a property of the bacilli themselves and not of the medium of growth.

Cultures up to the fifth generation were made and the following facts were arrived at: A single exposure to the x-rays increased growth markedly, and along with it there was an increase of chromogenetic property, even though grown in the warmth. As is well known, the bacillus prodigiosus does not form pigment when grown in a warm atmosphere. Further exposure to the rays so stimulates the growth as to again deprive the bacilli of power to form this peculiar pigment in the warmth, though on return to cold this property is afterward recovered to such an extent that this amount of pigmentation, though slightly different in color, is in excess of the original culture. Up to the fifth generation the result of exposure for an hour to x-rays of the culture is to produce an exuberant growth—apparently the pigment power is somewhat altered.

The method of application of the x-rays was as follows: With a large 18 in. spark coil of Newton's make a power was used of 16 volts, and from 8 to 10 amperes. The focus tube was placed about 6 in. above the test tube containing the potato growth. In every instance the exposure was of from fifty to sixty minutes' duration, with occasional resting of the tubes, which were run with the anodes as nearly red hot as practicable.

We do not here attempt to enter into

the explanation of these phenomena of growth. We are content to record the facts that exposure of the bacillus prodigiosus to the radiations of a focus tube induces very marked increase of growth and peculiar changes in the pigment-forming powers of this particular micro-organism. We will merely add that in some of the lower forms of vegetable life the same changes are observed, notably in the protococcus. An exposure of this organism to x-rays for from five to ten minutes appears to much stimulate its activity, and if the exposure is a little prolonged the cells become much paler, the chlorophyll disappears, and the protoplasmic contents are more granular. The cells recover their green color when exposed to sunlight, but on renewed exposure to x-rays the chlorophyll seems to disappear more or less completely.

The following microscopic changes are to be noticed as the result of exposure of these bacilli prodigiosi to x-radiations. There is apparently little to call for notice as regards the relative size of the rayed and non-rayed bacilli. As regards grouping, an unusual property of the bacillus prodigiosus was apparent—that is, growth in chains or strepto-bacteria; and further, what is at present giving rise to a controversy, spore formation, which seems to be clearly established by the presence of a chain preparation. For the rest, the bacilli appear in both cases equally granular and stain equally at the ends and as irregularly.

We are continuing these experiments, especially upon the pathogenic bacilli, among which it is possible that changes in growth may be accompanied with some alterations in the character of the bacilli.

THE Creighton Medical College, of Omaha, has recently added to its already very complete equipment an x-ray outfit of the latest and best make.

How Best to Secure Exact X-Ray Indications.

Having read with considerable interest the description of the Fessenden x-ray apparatus in your last issue, I can not but feel surprised at the fact that in this and many other recent articles in various electrical journals reference is made to the fact that photographs or radiographs are still being taken in connection with x-ray work, while it is a well-known fact that by the use of the fluorometer a great saving in time and tubes is effected, and much more accurate work done.

To properly locate a bullet in almost any portion of the body by photography requires the making of two radiographs; the work on which, including the taking, developing, fixing and printing, takes fully two hours' time, and the surgeon has even then to probe for the bullet to a large extent by guess work, guided, of course, by the two radiographs before him. Now not only does this process take up some two hours of valuable time, but the long exposure deteriorates to a great extent the tube which is used, so that the expense is great compared with the work accomplished. In using the fluorometer the patient is laid upon the table, the instruments are adjusted, the tube is turned on for a total of not more than five to ten minutes, and the patient's body is marked at four different points, which represent the terminals of two lines crossing each other at right angles at the intersection of which the bullet is absolutely sure to be found. In this case, as you will note, the marking is direct upon the body and no error can possibly be made by the surgeon.

In view of these facts, it is almost impossible for me to conceive that any one could resort to the taking of a radiograph in the present advanced state of the art. — *The Electrical Engineer*, July 21.

W. J. CLARKE.

New York, July 13, 1898.

A THEORY IN REFERENCE TO THE ORIGIN AND CHARACTER OF X-RAYS.

BY GEORGE ADAM, M. D.
Lecturer on Electro-Therapeutics, College of Physicians and Surgeons, San Francisco.

Jean Perrin enunciated the following theory in reference to cathode rays: That, there being an intense electric field in the vicinity of the cathode, some of the molecules of risidual gas are torn into ions. The negative ions start toward the positive pole, but, gaining sufficient velocity, they go outward in straight lines independent of the anode. The positive ions move toward the cathode. Accepting this hypothesis, the writer would extend the theory in explanation of x-ray phenomena. Supposing we have a residual gas such as carbonic acid (CO_2). Disintegration takes place at the cathode, the carbon seeking the cathode, the oxygen starting for the positive, but acquiring an enormous velocity which is capable of overcoming the attraction of the anode, if that pole is not directly in its path.

The oxygen ions are electrified by the current.

The forces, therefore, that are active in this stream of oxygen which form the cathode rays are as follows:

A large kinetic potential, an electric charge, an atomic attraction or adhesive force, and an atomic separative force, owing to the high exhaustiou of the tube and increase of intermolecular space. To what extent do these forces act together, and to what extent do they oppose each other? I would reason that the electric charge would strengthen the atomic adhesion, and thus keep the atoms in a molecular state, whereas the velocity and the rarity of the gas would act in the opposite direction to separate the atoms and break up the molecule.

The characterics of the cathode rays prove that the molecular condition is maintained. The chemical action, therefore, that would take place at the cathode is represented thus:

$$(CO_2)_2 = C_2 + (O_2)_2,$$

and the cathode rays would be represented by the formula

$$O_l + O_2.$$

It will be well here to consider the relationship of an electric charge to atomic adhesion. An electric current passing through a solution of a substance whose atomic constituents have different polarity will produce molecular disintegration; but there is no evidence, however strong the current, that atoms of the same polarity would be separated. On the contrary, atomic adhesion is a form of magnetism, which latter obeys the same laws as electrification and may be identical. Or it may be stated thus: That it requires positive and negative electricity to produce molecular disintegration in the electrolyte. In this instance the oxygen molecules are acted on by the negative electricity of the current.

The cathode rays bombard the fluorescent spot as molecules.

What do the cathode rays lose at the bombarded spot? They lose their electric charge. This is proved by the difference of the action of x and cathode rays in charging and discharging bodies. Do they lose any of the velocity? No; because there must be a reverse stream from the bombarded spot to establish an equilibrium in the exhaustion of the tube. This reverse force acts only at the commencement with the x-ray stream.

Then, what forces are active in this stream of radiant energy as it leaves the bombarded spot? The kinetic force, the separative force, owing to the increased intermoleculur spaces, and the atomic adhesive force (assuming that this last is a magnetic force, some of it may also have been lost in the bombardment).

We have, then, two disintegrating influences capable of overcoming the one adhesive force, and as a result the mole-

cule is torn to pieces. Issuing then from the bombarded spot is a stream of atoms, in this case of oxygen, with an immense kinetic potential and intense chemical potential. The formula would be

$$O+O+O+O.$$

The stream is sent out in straight lines from the bombarded spot, the same as the cathode rays issue from the cathode.

Let us consider some of the characteristics of the x-rays, and see if they can be accounted for by our atomic theory. The penetrating power of atoms must necessarily be greater than that of molecules, and in this respect comparison with other radiant energies supports our theory. The penetrating power would be different in different media owing to the chemical action, and as the stream would decrease in velocity the chemical action would assert itself.

Would not the bad effect produced by long exposure to x-rays be accounted for by the chemical action of the atoms on the tissues?

Having lost its electric charge and perhaps some of its magnetic adhesive force, such a stream of atoms would not be expected to be influenced by a magnet, but being infra-normal in this respect, when passing through a body would draw magnetism from the body, even if the latter was in a state of zero. This would account for the rays being influenced by the magnet after passing through a silver leaf.

A similar explanation will apply to the x-rays being incapable of charging a body electrically, and of its power to discharge a body already charged.

The x-rays are not generated in Geisler tubes because the intermolecular spaces are not large enough to assist in the work of disintegration of the molecule, and we have in that case a molecular stream.

In reference to Righi's experiment, showing that bodies in the neutral state were positively electrified by x-rays, I would offer this explanation:

The x-rays take away negative electricity from such a body and leave the latter positively electrified by the body's own electricity.

Thompson's experiment, showing that the penetrating powers of x-rays varies with the vacuum, that is, the higher the vacuum within certain limits, the greater the penetrating power, may be explained in this way: The enlargement of the intermolecular spaces is followed by a greater inter-atomic space in the stream. As the rays meet resistance the space between the atoms becomes smaller, and when the space is entirely obliterated the atoms unite and form molecules. It follows that the larger the space, the longer time it will take to obliterate it, and therefore the greater the distance traveled. This explanation would also account for there seeming to be two or more kinds of rays differing in penetrating power.

Such a ray as described, which we might call the atomic ray, would not be expected to be found in sunlight, nor any artificial light known, and the x-ray is not so found.

Radiant energy, consisting of a stream of atoms, would be a real ray, and would not be characterized by refraction, diffraction or interference phenomena, such as wave motion is, and no such characteristics have been found in x-rays.

A stream of molecules, or particles, would not be expected to produce all the phenomena characteristic of a stream of atoms, and accordingly we find no real ray obeying the same laws as the Roentgen ray.

CALORIFIC ACTION OF ROENTGEN RAYS. Dorn. *Wied. Ann.*, 63, p. 160; abstracted in *L'Eclairage Elec.*, June 17.—He measured the calorific effect by means of the differential pressure indicator of Toepler.

ON THE VISIBILITY OF ROENTGEN RAYS.

BY PROFESSOR E. DORN.

(Translated from the German.)

Doubt has been thrown* by certain physiologists upon the researches on the the visibility of Roentgen rays carried out† by Herr Brandes and myself; while at the same time the opinion has been expressed that we had allowed ourselves to be deceived by subjective light-phenomena (especially by those termed "accommodation phosphenes," arising from the muscular effort of focussing, or "accommodation") and by electrical influences.

So far as any unprejudiced readers of our detailed article in the *Annalen* are concerned, those objections disappear of themselves. Therefore, I will not again refer to my refutation given in another place, but will only submit some experiments which, independently of their special bearing, may perhaps be of some interest.

The question whether the stimulation of the eye by Roentgen rays can be ascribed to the conjoint effect of a (muscular) accommodation of a subjective sensation of light evoked thereby can be immediately decided by experiments upon an eye with paralyzed accommodation. Herr Scholdtmann, M. D., has had the extreme kindness to treat one of his eyes with homatropin, and to place himself at my disposal for observation.

On May 25th, 1897, in the evening, by bringing his head, carefully wrapped up so as to exclude light, near to the Roentgen tube, the appearance of light was observed to be only a little weaker in the paralyzed eye than in the normal eye. At midday on May 30th the difference seemed more evident, but it disappeared after a sojourn—half an hour long—in darkness. It was, therefore, obvious that the paralyzed eye had been blinded by the reason of the widening of the pupil in passing across the street in the bright noonday light. The stimulation of the sensation of light by the Roentgen rays resulted independently of the effort of accommodation.

With the co-operation of Dr. Rittenberger, I have made a series of researches upon the possibility of a stimulation of the nerves by electrical actions taking place in the neighborhood of the head. A cardboard cylinder was placed over the head, and rendered light-tight by means of velvet. Under these circumstances it was definitely ascertained that the observer saw the Roentgen rays distinctly. An aluminum sheet, 1·03 millimetres thick, 60 centimetres long, and 45 centimetres broad, somewhat weakened the appearance when interposed, but did not produce extinction of the phenomenon. Then I allowed the sparks (10 centimetres long) of the induction coil, which had supplied the tube, to jump across the space previously occupied by the tube at a distance of about 10 centimetres from the eye; *there was not, however, the faintest sensations of light.* Equally little was this the case when using a Himsted's apparatus for Tesla currents, although I experimented with spark-lengths of 4, 6, 10, and 16 centimetres, and with horizontal and vertical positions for the spark-path.

Corresponding observations were made with another arrangement of head-covering—namely, black paper over the eyes, and velvet over the head—with similar negative results, in spite of the fact that in this case the length of the Tesla sparks was increased to 21 centimetres, and the observer was situated with the region of his eyes in the glow of the discharge.

The most striking refutation of the suggestion that the sensation of light excited by Roentgen tubes is an illusion

*See Proceedings of the Physiologischer Gesellschaft of Berlin, May 7, 1897.

†See G. Brandes, Sitzungsberichte d. k. Akad. d. Wissenschaften zu Berlin, May 7, 1896; also G. Brandes and E. Dorn in Wiedemann's Annalen, vol. lx., p. 478, 1897.

due to electrical influences is, however, afforded by the following experiment:

The Roentgen tube was turned backwards, that is to say, with the back of the anti-cathode presented towards the eye. The eye, accustomed to darkness, could not detect the smallest action, although the appearance of light was distinctly seen, both before and afterwards, with the tube in the right position. The tube thus reversed in position produced only a very faint fluorescence upon a barium-platinocyanide screen.

Meantime, Herr Roentgen has himself confirmed the visibility of the rays discovered by him, and has given‡ an elegant modification of the fundamental experiment. If an absorbing metal plate with a narrow slit in it is held before the eye, there is perceived a bright line, which is either straight or curved according to the relative positions of the anti-cathode, slit, and eye.

Before I had received information of this, I made a similar observation, in which I saw the "Roentgen shadow" of a straight brass rod 5 millimetres thick appearing under certain conditions as a curved shadow upon the retina.

The result of both experiments is easily explained. To me my experiment was important, because I perceived the curvature by observation without any previous deliberation, and the unexpected result offered, therefore, a welcome confirmation for the view that I was not dealing with an illusion due to subjective phenomena of light.—*Wiedemann's Annalen. Archives of the Roentgen Rays.*

CATHODE RAYS. Battelli and Garbasso. *Nuovo Cimento,* Vol. 4, page 129, and Vol. 6, page 5; abstracted in *L'Eclairage Elec.,* May 7.—A paper discussing the action of cathode rays on insulated conductors. The results agreed with the hypothesis that the difference between the action of cathode and Roentgen rays depends essentially on the conditions of the medium which surrounds the electrified conductor.

‡ Roentgen: Sitzungsberichte d. k. Akad d. Wissensch. zu Berlin, May 13, 1897

THE following is a list of books published on x-rays:

Manual of Static Electricity in X-Ray and Therapeutic Uses, by S. H. Monell, New York.

The New Photography, by A. B. Chatwood, London.

Prof. Roentgen's X-Rays and Their Application in the New Photography, by August Dittmar, London.

The X-Ray, or Photography of the Invisible, by W. J. Morton and E. W. Hammer, N. Y.

The X-Rays, by Kolle, N. Y.

Practical Radiography, by A. W. Isenthal and H. Snowden Ward, F.R.P.S., London.

The Roentgen Rays in Medical Work, by David Walsh, M. D., (Edinburg).

La Technique Des Rayons X, by A. Hebert, France.

La Radiographie Appliquee, a L'Etude des Arthrapathics Deformatics, by Dr. F. Bayou.

Roentgen Rays and Phenomena of the Anode and Cathode, by Edward P. Thompson, M.E.E.E., N. Y.

Les Rayons X, by M. Ch. Guillaume, Paris.

The A. B. C. of the X-Rays, by W. H. Meadowcroft, N. Y.

The Induction Coil in Practical Work, by Lewis Wright, London.

IMMERSED LUMINOUS ELECTRODES. Braun. *Wied. Ann.,* No. 6; abstracted briefly in Lond. *Elec*, July 8.—Aluminum electrodes can be used for the chemical rectification of current; in this connection he discovered that the aluminum electrode in the electrolytic cell emits over its whole surface a white or yellowish red light. The phenomenon is best studied by means of a thin strip or wire of aluminum, which is viewed in a revolving mirror. The luminosity gradually disappears with a constant current.

COLLES' FRACTURE AND THE ROENTGEN RAYS.

BY CARL BECK, M. D., NEW YORK.

Colles' fracture is the commonest of all fractures, yet in regard to no other is there more difference of opinion as to treatment. Since the advent of Roentgen rays, our knowledge of fractures and dislocations has been greatly enlarged, and our methods of treatment revolutionized. Treatises on this subject which were written before the Roentgen era have ceased to be regarded as authoritative. Following the new discovery great interest was at once concentrated on the much disputed classic fracture of the lower end of the radius, and it soon became evident that a much greater variety of the different types of this fracture (which represents ten per cent. of all fractures) exists than was ever anticipated before. As far as my own experience is concerned, I must admit that I never saw a case in which the diagnosis made before a skiagram was taken was not more or less modified thereafter, especially when considerable effusion and swelling were present.

Since March, 1896, I have observed forty-four cases of Colles' fracture, all of which were skiagraphed. Most of the skiagrams revealed conditions not thoroughly anticipated when examined by the usual methods. One most surprising feature was that in nineteen of these cases *a distinct transverse fissure above the capitulum ulna* existed, without causing any apparent symptoms. In seven cases the styloid process of the ulna was entirely broken off. In some instances besides the typical transverse fracture there was also a vertical fracture of the radius, which reached into the radiocarpal joint. In fourteen cases there was no displacement in spite of the great extent of the lesion, the periosteum of the dorsal surface apparently having kept the fragments together.

There is a different plan of treatment to be pursued if there be a total separation of the lower end of the radius or only a fissure with little or no diastasis. It is of great importance to know the direction of the line of fracture, whether it extends into the joint, and whether or not there is any impaction. Sometimes there is a decided turning of the fractured end, its upper margin being forced toward the ulna while the lateral margin protrudes and the joint-surface is directed upward to the dorsum. It is apparent that in all such cases unless thorough reduction is at once made the function of the wrist will never be restored; and, *vice versa*, if the fracture-line extends upward from the volar side and downward to the dorsum, the displacement must occur in the opposite manner, the principle of reduction, however, remaining the same. If the direction of the fracture-line is oblique it generally extends into the joint—a point which has to be especially considered in the after-treatment. The method of reduction as well as of applying the dressing will also be modified when there is a fracture of the ulna or of its styloid process, or when a bone particle has been chipped off. These lesions are diagnosed with difficulty by ordinary methods, even when the manipulations are skilled, and are seldom recognized by any other means than by the Roentgen rays.

In the treatment of all fractures there are two very simple rules to be observed: (1) Replace a displaced fragment to its normal position, and (2) keep it there. If the skiagram does not show displacement, there is, of course, no need of reduction. This explains why the results in certain cases of Colles' fracture are always good, no matter what sort of treatment is employed. In fact, if treated by a quack, whose ignorance leads him to treat the injury as a sprain with an ointment, poultice, or with "faith," often a better result is obtained in such

ordinary cases than by the learned medical neophyte, who, after having made a most erudite diagnosis, immobilizes the joint for too long a period in his zeal to keep the fragments together; there will be no deformity, but adhesions will be formed and the wrist will remain stiff or immobile. In such a case a patient, the motion of whose hand was not prevented by immobilization, would escape serious consequences. In all cases in which displacement is present of course a great amount of care and deliberation is necessary.

The first requirement, accurate reduction, may be carried out with little difficulty. If forced extension and downward pressure by the surgeon's thumb, while counter-extension is used on the forearm, flexed rectangularly, should fail, anasthesia must be employed. But the more difficult thing is to keep the fragments well adjusted in a proper position. This I have always been able to secure by applying a long adaptable wire splint reaching at the flexor side of the arm from the tip of the fingers to the elbow, the splint being applied while forced traction is made. If the direction of the displacement is upward—*displacement a la fourchette*, a pad of adhesive plaster is attached to the dorsal integument above the fragment. Then a short narrow splint of wood is placed on the dorsal aspect of the arm, reaching from the metacarpo-phalangeal joint to four inches above the wrist, and is kept pressing down by the application of a gauze bandage. If the tendency of the displacement is downward the same procedure is carried out in the opposite manner, the wire splint being applied on the dorsal and the wooden splint and pad on the palmar side of the arm.

If the displacement be sideways, which is generally the case when there is a simultaneous injury of the ulna, the immobilization must be carried out on entirely different lines. The adhesive-plaster pad must then be applied laterally to the fragment, two long, narrow, wooden splints being used at the same time. One of these splints, being a little broader than the diameter of the bone, begins at the metacarpo-phalangeal joint of the thumb, and the other at the same joint of the little finger. Both extend up to the elbow, the same as the long wire splint. If there should be any displacement to the opposite direction, the pad must be applied on the ulnar side. No dorsal splint is used in this variety. After the dressing is finished, the skiagram verifies the proper positions of the fragments. If there be much swelling, wet applications may be advantageously used by pouring a solution of acetate of lead, for instance, upon the gauze bandage, the wire splint permitting penetration of the fluid.

It is of the greatest importance in such cases, that the fragments after being properly reduced, be kept *in situ*. The extremely strong ligamentum carpi volare never breaks, as Nelaton well demonstrated, and, therefore, it is in the first instance the *bone* which has to be taken care of.

If after the lapse of a week agglutination of the fragments is obtained and no deformity is evident, then the soft tissues must receive consideration. It is only then that short splints are in order. They consist of well-padded pieces of wood, extending from the metacarpo-phalangeal joint up to the middle of the forearm. After another week they extend only to the wrist, thus permitting free motion of the hand. The patient is told to move his fingers, as in playing the piano. After the third week massage treatment is indicated, active as well as passive motion of the joint being employed at the same time.

If all these points are observed, and if their proper execution is certified by the

skiagram, surgical clinics will no longer furnish so much testimony of deformities and functional impairment following Colles' fracture.

The writer then cites three illustrative cases, and ends by stating that nothing may inculpate or exculpate a surgeon more than a good skiagram.—*Medical News.*

St. Louis, Mo., May 13, 1898.

MR. C. C. ZIEGLER.

My Dear Sir:—I had the pleasure of reading a verse in one of the city publications the other day which attracted my attention and admiration. The beautiful sentimental reference to the x-rays therein contained endears the verses to me and makes the ode appropriate for publication in THE AMERICAN X-RAY JOURNAL. Will you give me consent for its publication? What incentive caused you to compose these lines?

Thanking you in advance.

Yours Truly,
HEBER ROBARTS.

In Mr. Ziegler's reply he said: "The beautiful x-ray views of the pulsating heart seen in Dr. Graves' office was the sole incentive for writing these lines."

The following is the sonnet as it appeared in *The St. Louis Public Library Magazine* for April, 1898:

SONNET.

Where is old Jove, the ruler of the sky,
Who in his hand the forked lightnings bore?
Where is Prometheus? Where the thunderer Thor
Whose glittering hammer made the mountains fly?
Dreams of the man-child! His believing eye
Saw in the forces he could not explore
Gigantic beings whom he must adore,
Appease, and e'en with blood their favor buy.
We have unroofed the heaven the ancients knew;
The lightning is our slave; through Roentgen's rays
The throbbings of the human heart are seen.
How have the gods of old faded from view
Before our modern searchers' vision keen!—
All faded, leaving but a little haze.

CHARLES CALVIN ZIEGLER.

The X-Rays and Their Safe Application. Destruction of X-Ray and Other Infections by Electro-Sterilization.*

BY J. MOUNT BLEYER, M. D., F. R. A. M. S., LL. D., NEW YORK CITY.

Discoveries of the properties of the x-rays go on apace and the scientific world is watching with the closest interest the experiments that are being made from their different aspects, to determine the effect of these rays upon the human body. Since their discovery and their application in medico-surgical work, reports soon started and spread throughout the profession and lay public of a grave danger accompanying the use of these x-rays, owing to the fact that they produced so-called virulent burns by exposure to them.

Records now hold amongst their files many cases—differing in degree, and some have proven fatal from a lingering exposure to them. Even records tell us of a recent murder trial in this state in which the chief question arose—whether the physician who made this x-ray exposure upon a patient, was guilty of an act of negligence from which death followed.

Let me say at the outset of my remarks, from what I gathered from my experimental work, that all your timidity in their future application can be allayed. I concluded that if the x-rays are applied under certain precautions, and the proper apparatus used, no such conditions can be possible. I speak now from the actual employment of these rays daily to the chest wall, for the aid in gaining early diagnostic signs of tubercular and other allied diseases, if present.

This investigation gives me the right of an opinion, and I freely make it before you, showing how we all have fall-

*Read before the Psychological Section Medico-Legal Society, May 26, 1898.

en into that fallacious position by calling this phenomena as produced by these x-rays, burns, when they are nothing less nor more, than an inoculation. Now that we know how to remedy the dangers connected with their use, and how best to avoid repetitions from recurring, and if they occur, whether the physician, or who so applies them, is to take the blame if the proper precautions, as in any surgical operation, are not observed. Of all these facts I shall refer to in a few moments.

Let me dissipate those minds that an x-ray application or the use of its photography is a dangerous procedure, either on a long or short exposure. If this force is applied and handled by skilled hands and suitable mechanism, there is absolutely no atom of fear in producing this phenomena of inoculation, known fallaciously as x-ray burns.

This inoculation is due, according to my observation from a series of experiments, to several physical effects produced by the generation of these rays and the general conditions present. It is a known fact, that the use of the Rhumkoff coil, in connection with the generation of these rays, is an apparatus which gives an exceedingly high electromotive force and amperage, and therefore such high discharges when exhibited produce certain physical conditions surrounding the atmosphere of the patient or person who is exposed to these x-rays. To sum up these physical facts, we find that this high discharge is leveled against the subject, carrying with it from the surrounding septic atmosphere, certain particles floating therein, also surcharged with bacteria and foreign material upon the clothing and skin which are at all times present, setting up sometimes an infection and at other times an inflammatory condition from these forced driven materials under the skin exposed to this phenomena.

This inflammatory or inoculated condition is the result of all these facts which I came upon from my crucial experiments, and can be avoided without any difficulty now on the part of the operator, by the adoption of a few rules gleaned from my experience which I shall give in the summing up of my remarks.

I bring before your notice a few most important facts, which are also corroborative directly within my own investigation. Those facts can not help being appreciated, as they come also from several late observers who studied the question of burns, due to fire and hot water, &c., and the causes of death therefrom.

We already know that many deaths are due to burns produced from other causes than by the x-rays. This fact has puzzled scientists to account for deaths which occurred among persons suffering from burns, even where the injuries received seemed wholly inadequate to produce fatal results. The havoc caused by skin diseases might be much greater, and a far larger surface of the skin attacked, but generally a cure could be effected, whereas, in the majority of cases of severe burns the end would be fatal.

Persons who have escaped with their lives from a fire whether very severely burned or otherwise, suffer intense pain, which is followed by a peculiar torpor and drowsiness, and not infrequently by delirium and convulsions. The pulse becomes weak, the breathing irregular, the temperature lower and there almost always follows vomiting and other symptoms of poisoning, terminating within twenty-four to twenty-eight hours in death.

Although these symptoms have received the attention of a number of scientists, their views of the actual cause of death were widely diverse. The first guesses, though ingenious, were very far from the truth. A German, F. Falk, arrived at the conclusion that persons

suffering from burns died of cold, caused by the abnormal amount of heat given off through the burned portions. Prof. Ponfite, on the other hand, believed the cause to be the destruction, by the heat, of a great number of blood corpuscles, inducing a disturbance of the circulation. Addakoff, a Russian physician, stated as his view, gained from clinical observations, that the results of burns upon the system bore a resemblance to the effects produced by certain poisons, particularly those generated in the body by the failure to throw off secretions. Lustgarten and Kijanitsin come still nearer to the truth. The former comparing the results to burning with that of ptomain poisoning, and the latter declaring that under some influence or other, probably that of a ferment or of bacteria, a poisonous matter developed in the blood of burnt persons. He actually found in the blood of such persons a poison (ptomain) that is not present in normal bodies. It is a formless, yellowish or brownish yellow matter, with a sharp, disagreeable odor and injected into dogs or rabbits produces all the symptoms caused by burning. The belief of Lustgarten that bacteria causing impurities, which settled in the wounds, were the generators of the poison, was shown by the experiments of Ajello and Parascandolo to be unfounded. Both these were able to take from any part of the body of a burnt animal, a poison, the injection of 10 grammes of which into a dog, weighing twenty pounds, produced instant death. The strongest poison was obtained from the burned flesh, a lesser was in burned entrails and the weakest of all came from the blood. From this may be deducted, with certainty, that the ptomain is not solely in the blood but in the whole of the burned portions and is thence carried into the system. Burned persons poison themselves, so to speak.

The poison may be regarded as the product under the influence of high temperature of the albumen, and the direct importatlon of bacterial poisons from without, &c. It has been found possible, however, to prevent the poison from spreading by removing the burned portions before the ptomain had entered the circulation. It is also known from Ajello's and Parascandolo's experiments with animals that all recovered without having suffered from the symptoms incidental to burns, when the amputation of the burned parts occurred immediately after the burns were received; where the amputation was delayed for twenty-four hours they all succumbed, except in instances where large quantities of blood were removed by bleeding; the blood drawn off being replaced, however, by a transfusion of pure blood. By the bleeding a large quantity of the poison was removed, the blood artificially supplied so strengthened the animals that there was facilitated a further separation of the poison from the blood by means of the kidneys.

I lay much stress upon this important point due to these x-ray phenomena. That the x burn always appears many days after the application of this force or light to a part of the body, and does not show absolutely any early manifestation, —as minutes or hours thereafter, but days elapse, even as late as 18 days thereafter. The x-ray burn begins with a painful dermatitis slowly, and symptoms resembling burns from heat or scales. It is therefore that from the very outset and conditions that the difference is apparent.

How should we avoid this dangerous condition in the application of the x-ray?

To sum up in a few clauses the whole matter, let me say in a few words the following, viz.:—

Above all supplant the static machine for the Rhumkoff coil. This form of electricity has not the physical properties of carrying foreign material into the

depths of the tissue so readily as the other current. Static electricity gives only the high voltage with low amperage, while the other is productive of both high forces, making it an unnecessary dangerous appliance.

All parts to be either photographed or examined by means of these x-rays should have all clothing removed therefrom, and washed with an antiseptic solution, or so prepared as if a surgical operation is to be performed. Also, a room which is free from infectious materials as possible, should always be made ready, or especially appointed for the purpose. Those are the cardinal rules and must not be deviated therefrom in order to avoid a dangerous inoculation or poisoning. A screen of aluminum is a good adjunct also, and should be employed whenever convenient.

SPECIFIC TREATMENT FOR SUCH. CONDITIONS.

Should such a condition arise, from unforeseen causes or otherwise, sterilization of the affected part by means of electrolysis is the safest and quickest specific known to me—with the amputation of loose tissue surrounding the parts. I found in my early work, as far back as May, 1896, when I had been as unfortunate as others to inflict several patients with these burns, that something more was present to deal with than an ordinary electro dermatitis. Experimental study of this question soon elicited facts that brought me to the discovery of the following remedial agent, which I recommend to your notice. Electrolysis or sterilization of the parts is a specific.

What do we understand by Electrolysis?

Electrolysis is the act of breaking up of chemical compounds, organic as well as inorganic, into their constituent elements by the agency of electricity, the process being accompanied by the loss of heat, and, usually, by change in the volume of the substance submitted to experiment. The conditions requisite for the performance of electrolysis are: (1) A fluid or semi-fluid conductor; (2) Conveniently placed electrodes; (3) A continuous or galvanic current of sufficient electro motive force or strength of electricity to overcome the resistance interposed between the electrodes. As the result of the passage of a continuous current, through a suitable conductor, decomposition is the result. The current decomposes all the infected material and changes them into some other non-poisonous compound, thereby relieving the system of poisonous products. This is accomplished by placing such parts of the body into a salty solution of distilled water, and connecting the electrode with the negative pole of a galvanic battery with a mil-ampere meter. The positive pole may be placed on any convenient part of the subject—vessels of porcelain, wood or glass are best. The strength of this current should average 5 mil-ampere to a square inch of surface to be sterilized, lasting at least ½ hour, after that time the polarity should be reversed for 5 minutes, in order to set free the chlorine which will again react on all the external and internal exposed surface. Accurate measuring by means of a mil-ampere meter with the use of such current must be strictly adhered to, as serious conditions will arise unless one knows the exact amount of current passing, and so as to judge the exact quantity of chemical action, thereby controlling its destructive effects; which if are not known will do serious injury to healthy surrounding tissues.

I know of no more satisfactory and scientific methods in the treatment of these x-rays wounds, and, in fact, all deep and superficial wounds, than the sterilization by electricity as advocated in my method as stated. All wounds with pus should first be drained by incision before the above procedure is un-

dertaken. I must state in my recommending sterilization by electrolysis to those that will hereafter apply it that they should at least be acquainted with the fundamental principles involving electro chemistry. Good judgment is necessary, as much damage can be done if improper precautions are not observed. The time of application must be always left to the discretion of the operator, especially in deep seated conditions. Reapplications can be always resorted to. There are no contra indications for this treatment by electrical sterilization to any class of infected wounds and skin diseases presented to surgery. After such treatment, protective dressing of simple kind are necessary to keep the parts from further external infections.

I bring my new and novel investigation before your notice for the first time in the history of antisepsis, and hope that it will find its way into general surgery with as much, and better satisfaction than the heretofore methods employed, and give as good account of itself as it has in my hands.

This work has been the outcome of my early results obtained in the treatment of tuberculosis and other inflammatory diseases of the lungs, &c., which still occupies my time, already with most fruitful results.

My investigations brought me to a most important point, and that is, that all microscopic crevices are cleaned of bacilli and pus cells, where, with the use of antiseptic solutions, &c., a mere coating is effected thereby, and always liable to a reinfection. This form of sterilization does not absolutely admit of such a condition as destruction takes place instantaneously by chemical decomposition, also by reversing of the polarity of this current, these microscopical crevices are again closed completely by its electro dynamic action.

Electro-sterilization must be highly recommended as a prime antidote to all kinds of stings, dog bites, or in fact by venomous wounds produced by serpents. The current should be applied a much longer time than for ordinary cases. When a person has either been bitten by a poisonous snake, or by a dog, or received a dangerous dissecting wound, our first efforts to influence the result may take three directions: (1) To prevent the absorption of the poison; (2) To counteract or lessen its effect on the organism; (3) To hasten its elimination. (Martin.). With the first object a ligature should be tightly applied to the seat above the situation of bite or wound. Then electro-sterilization prevents absorption of any poison by electro-decomposition. Ligaturing delays the absorption of a poison, as venom from a snake, etc., until electrolysis is accomplished. Electrolysis should be performed at the earliest possible moment.

The Prompt Solution of Tablets.

The Best and the Cheapest.

In prescribing either medicine or nutriment, a physician must often consider the question of what is the most eco-

nomical as well as what is the best for his patient. And it is only occasionally that he is made happy by the knowledge that *The Cheapest is The Best.* He always knows that "the best is the cheapest," but this helps him very little if economy must be thought of.

John Carle & Sons point with pride to the fact that their prepared food, Imperial Granum, is the most economical as well as the best food on the market, and in proof of this, they ask physicians to carefully note the weight of their handsome "Small" and "Large" size air-tight tins, and also to kindly notice the length of time either one will last, bearing in mind that their sterilized tins form the lightest, as well as the safest retainer that can be used.

Send $1 and subscribe for THE AMERICAN X-RAY JOURNAL.

THE TREATMENT OF DISEASE BY ELECTRIC CURRENTS.

A handbook of plain instructions for the general practitioner. By S. H. Monell, M. D., Brooklyn, N. Y. Published by William Beverly Harison, 3 and 5 West 18th Street, New York. 1088 pages.

Another extremely valuable work on electro-therapeutics has been launched by the same author as the recent publication, "Manual of Static Electricity in X-Ray and Therapeutic Uses," which has attracted world-wide reputation thus early for its clearness of description, and usefulness to the general practitioner.

It would be impossible for us to specialize the headings of the 70 chapters in this volume in the space allotted for this review, therefore it must suffice to state that every known modern employment for faradic, galvanic and static electricity and their therapeutic indications are detailed in this volume with conciseness of language and minute directness of application, so that the general practitioner may read and understand.

Probably no book on electro-therapeutics, and we say it conservatively, has ever equaled this volume for value to those of the professioi who would use electricity as a therapeutic agent, and he who does not use it at this age is certainly not up to the times in his profession.

We therefore heartily recommend this volume to our readers, believing that they will not be disappointed in adding it to their libraries.—*Medical Times and Register*, Phila., Pa., January, 1898.

Manual of Static Electricity in X-Ray and Therapeutic Uses, ... $6.00
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